Species Diversity, 2004, **9**, 259–267

# *Acarothrix ampliata* (Arachnida: Acari: Halacaridae), a New Halacarid Mite from Florida, with Notes on External Genital Acetabula

**Ilse Bartsch**

*Zentrum für Marine Biodiversitätsforschung, Forschungsinstitut Senckenberg,*
*Notkestr. 85, 22607 Hamburg, Germany*
*E-mail: bartsch@meeresforschung.de*

(Received 26 September 2003; Accepted 12 March 2004)

The genus *Acarothrix* was to date known from southern China, northern Australia, and southeastern Africa. In this paper a new species is described, collected in the Little Manatee River, Tampa Bay, Florida, U.S.A. Males, but not females, of this genus have external genital acetabula.

**Key Words:** Halacaridae, *Acarothrix*, new species, description, Florida, freshwater.

## Introduction

Slightly more than a decade ago, Bartsch (1990) published a description of the halacarid genus *Acarothrix*. That first *Acarothrix* species, *A. palustris* Bartsch, 1990, had been taken in the upper intertidal along the shores of the Tolo Channel, Hong Kong. This was a muddy environment with extreme fluctuations in salinity, ranging from hypersaline during low tide, owing to evaporation of the sea water, to almost fresh, when the habitat was covered by fresh water for several hours after heavy rainfalls. The males of that species are characterized by "external" genital acetabula; the acetabula are not, as in most halacarid genera, situated inside the genital opening, recognizable only through the transparent integument, but on the genital sclerites and obviously opening externally. In recent years, another two species have been described: *A. longiunguis* Bartsch, 1997 from Darwin, Northern Territory, Australia, and *A. umgenica* Proches, 2002 from Durban, South Africa (Bartsch 1997; Proches 2002). Recently I received mites from a small river emptying into Tampa Bay, Florida, Gulf of Mexico, and these specimens were found to represent a new species of *Acarothrix*.

## Material and Methods

For the past decade, a monitoring program for benthic macroinvertebrates has been conducted in Tampa Bay and its larger tributaries on Florida's Gulf Coast under the supervision of S. A. Grabe, Environmental Protection Commission of Hillsborough County. Collections from the Little Manatee River (Fig. 1) yielded a small number of halacarid mites. Other arthropods in the samples were *Cyathura polita* (Stimpson, 1855) (Isopoda), *Gammarus tigrinus* Sexton, 1939 and *Grandi-*

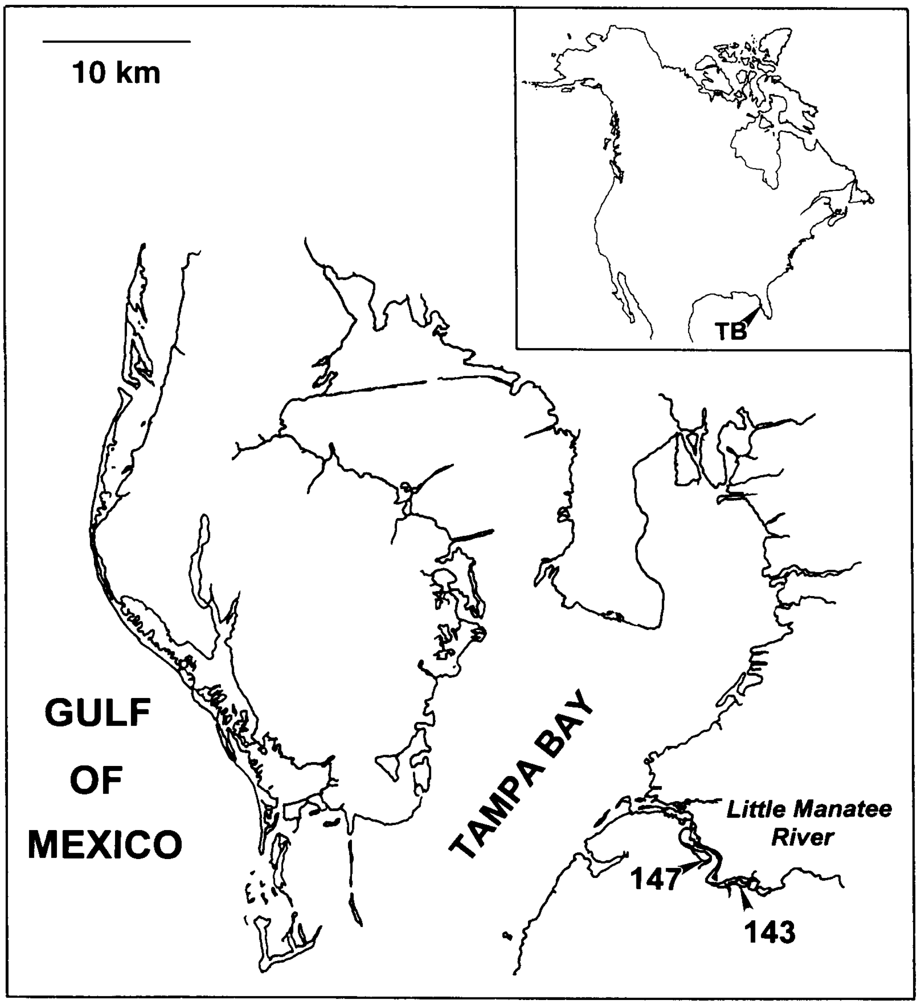

Fig. 1. Map of Tampa Bay, Florida, showing the two sampling sites of *Acarothrix ampliata* sp. nov. (Stations 143 and 147). TB, Tampa Bay.

*dierella bonnieroides* Stephensen, 1948 (Amphipoda), and *Almyracuma proximoculi* Jones and Burbanck, 1959 (Cumacea).

The mites are mounted in glycerine jelly between two glass coverslips. The holotype and a paratype are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A. (USNM), and further paratypes or voucher material in the Forschungsinstitut Senckenberg (SMF), Zoologisches Institut und Zoologisches Museum, Hamburg (ZMH), and National Science Museum, Tokyo (NSMT).

Abbreviations used in the descriptions: AD, anterior dorsal plate; AE, anterior epimeral plate; ds-1 to ds-5, first to fifth pairs of dorsal setae; GA, genitoanal plate; GO, genital opening; OC, ocular plate(s); P, palp; P-2 to P-4, second to fourth palpal segments; pas, parambulacral seta(e); PD, posterior dorsal plate; PE, posterior epimeral plate(s); pgs, perigenital setae. Legs are numbered I to IV; leg segments are trochanter, basifemur, telofemur, genu, tibia, and tarsus.

## Taxonomy

### Subfamily **Copidognathinae** Bartsch, 1983
### Genus ***Acarothrix*** Bartsch, 1990

**Diagnosis.** Dorsum with five pairs of dorsal idiosomatic setae and four pairs of gland pores on raised cones. OC with two pairs of setae. AE with epimeral pores. Male genital sclerites with one pair of external genital acetabula. Palps four-segmented, second segment with one seta, third segment lacking setae, fourth segment with three setae in basal whorl. Genua shorter than telofemora and tibiae. Basifemur II with three setae. Tibiae I to IV with two ventral setae each. Tarsus I with large ventral seta and one (or two) small setula(e); tarsi II to IV without ventral setae. Solenidion of both tarsus I and II in dorsolateral position. All tarsi with paired claws, central sclerite with claw-like process.

**Type species.** *Acarothrix palustris* Bartsch, 1990.

### ***Acarothrix ampliata*** sp. nov.
(Figs 2, 3)

**Type Material.** Holotype: male (USNM, No 2032160). Paratypes: one female (USNM, No 2032160, separate slide from Holotype), one male (SMF), one female (ZMH), one male (ZMH).

**Collecting data.** USA, Florida, Gulf of Mexico, Little Manatee River, Station 143, emergent vegetation, 0.6 m depth, salinity 0.2‰, pH 7.0, 12 September 2002.

**Further material.** One male (NSMT): USA, Florida, Gulf of Mexico, Little Manatee River, Station 147, 12 September 2002.

**Diagnosis.** Idiosoma wide. Dorsal plates almost evenly reticulated, ventral plates faintly reticulated. No marked cerotegumental ornamentation. Rostrum triangular, as long as gnathosomal base. Legs III and IV longer than legs I and II. Tibiae I and II with three dorsal and two ventral setae. Claws paired, slender, with minute accessory tooth.

**Description.** *Male.* Idiosoma 326–340 $\mu$m long (holotype 326 $\mu$m long, 242 $\mu$m wide), flattened, wide, almost unifrom in width in most part, with three small spots of black eye pigment. Dorsal plates reticulated (Fig. 2A). AD wider than long; anterior margin arched, posterior margin triangular. First pair of gland pores on small cones. OC large, 97 $\mu$m long, 77 $\mu$m wide, with gland pore on lateral margin and pore canaliculus somewhat posterior to gland pore, and with remnants of cornea. Length of PD 179 $\mu$m, width 140 $\mu$m; plate almost evenly reticulated, its very faint pair of costae obscured by reticulation. Anterior pair of pores on PD level with insertion of leg III, other pair near posterior margin of PD. Dorsal setae small; ds-1 on AD at same level as gland pores; ds-2 and ds-3 on OC; ds-4 and ds-5 on PD, almost equidistant from anterior gland pores. Adanal setae in ventral position adjacent to anal opening.

Ventral plates faintly reticulated. AE very wide, its length 97 $\mu$m, width 204 $\mu$m; posterior margin truncate (Fig. 2B). AE with three pairs of setae; epimeral pore present though not conspicuously enlarged. Small cuticular filaments on anterolateral margins of epimera and close to epimeral pores (Fig. 2C). PE with one

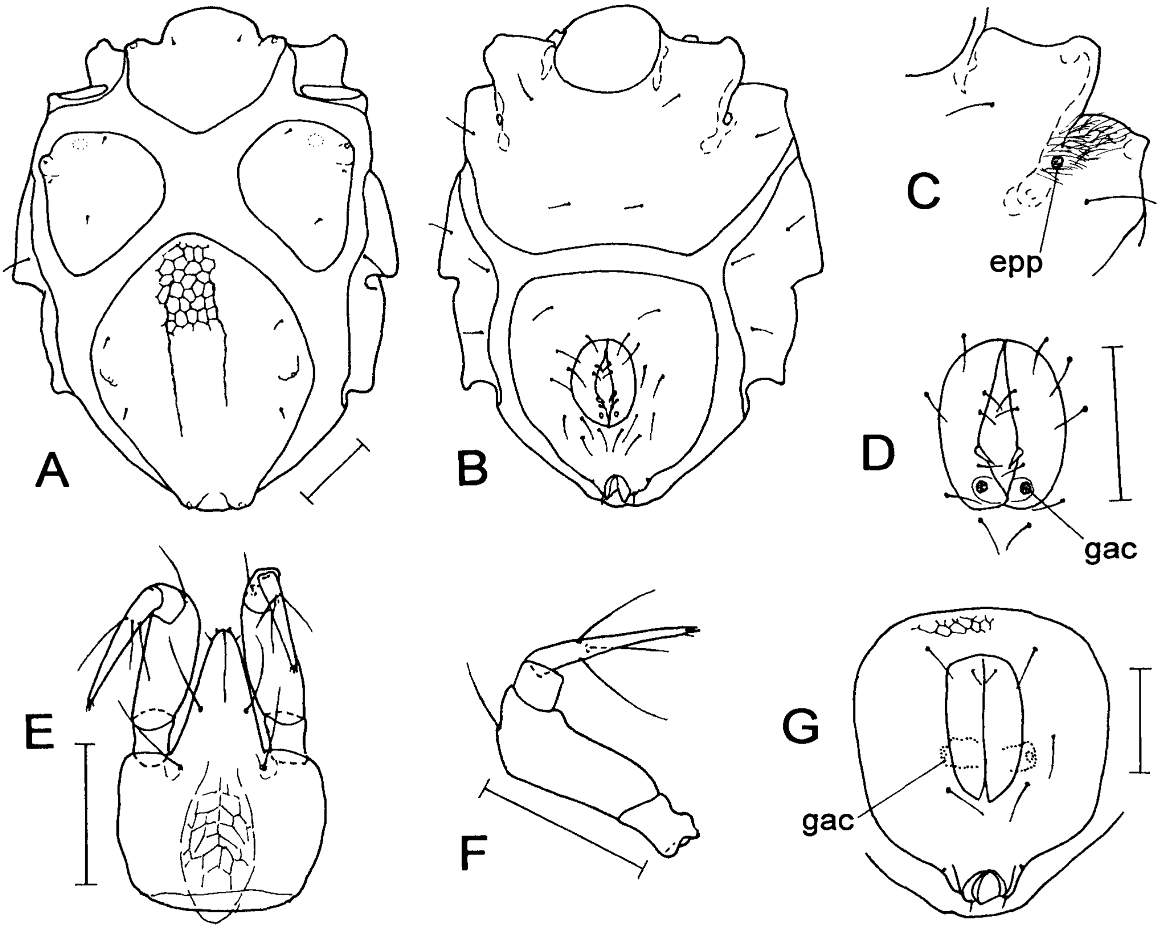

Fig. 2. *Acarothrix ampliata* sp. nov. A, idiosoma, dorsal, male; B, idiosoma, ventral, male; C, portion of epimera I and II, male; D, genital opening, male; E, gnathosoma, ventral, male; F, palp, male; G, genitoanal plate, female. A–D, G, holotype; E and F, paratypes. Abbreviations: epp, epimeral pore; gac, genital acetabulum. Scale = 50 μm.

dorsal and three ventral setae. Length of GA 152 μm, width 134 μm; anterior margin truncate. GO in middle of plate, its length 55 μm, width 42 μm. Spermatopositor large, length and width 92 μm, and slightly extending beyond margin of GA. Plate with 18 pgs. Genital sclerites with four pairs of subgenital setae (three setiform and one spiniform) and one pair of genital acetabula (Fig. 2D), without internal genital acetabula. Anus in ventral position.

Gnathosomal length 94 μm, width 70 μm. Rostrum about as long as gnathosomal base (Fig. 2E). Tectum slightly arched. One pair of maxillary setae on gnathosomal base, one pair on rostrum; tip of rostrum with minute rostral setae. Rostral sulcus extending to pair of maxillary setae. P-2 with one seta; no seta on P-3; P-4 with three setae basally, one setula and two spurs apically (Fig. 2F).

Legs III and IV longer and more slender than legs I and II, but all legs shorter than idiosoma. Leg segments without lamellae (Fig. 3A–D), tarsi without fossa membranes. Ventral flank of telofemora with delicate filaments. Leg chaetotaxy (from trochanter to tarsus, famulus and pas omitted): leg I, 1, 2, 5, 4, 5, 6; leg II, 1, 3,

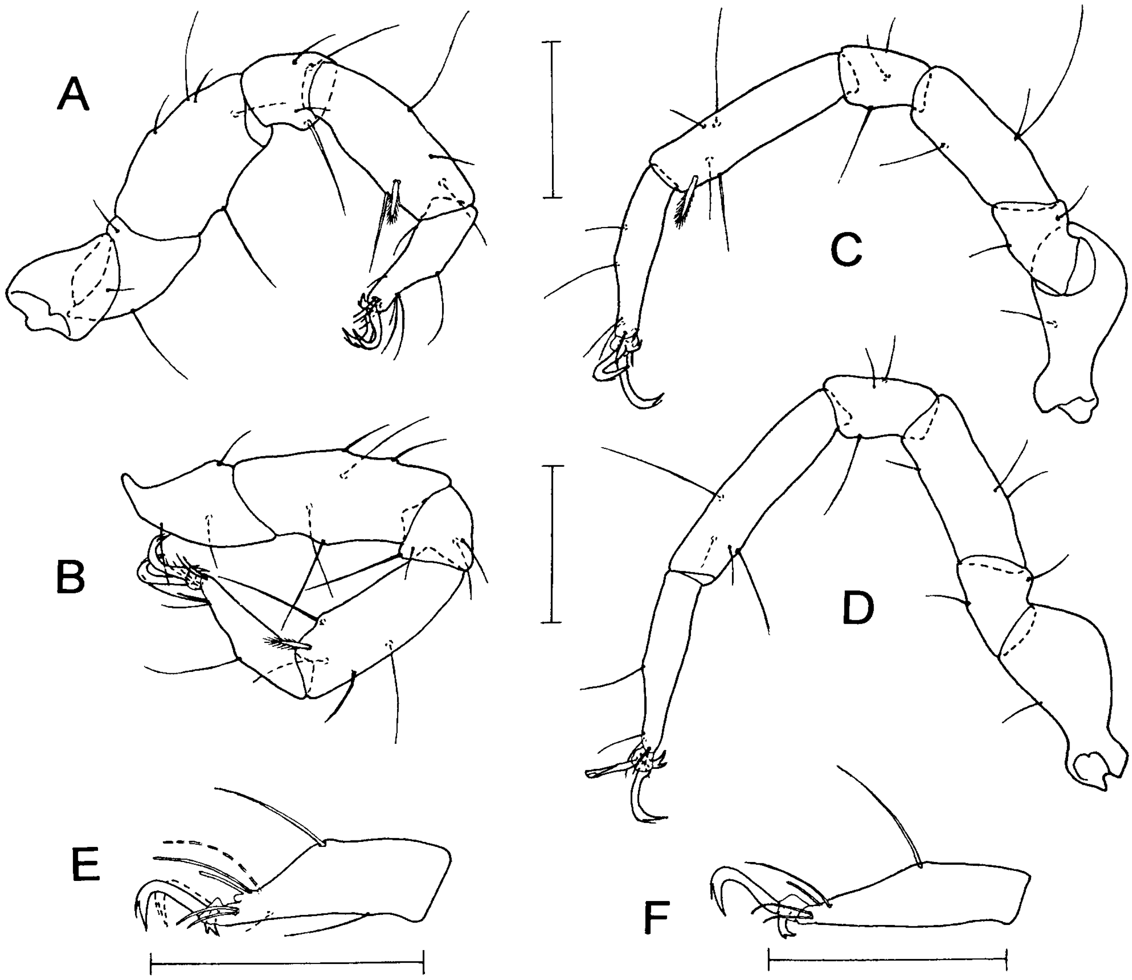

Fig. 3. *Acarothrix ampliata* sp. nov., holotype, male. A, leg I, medial; B, leg II, trochanter to tarsus, medial; C, leg III, medial; D, leg IV, medial; E, tarsus I, lateral (medial setae and claw shown in broken line, medial pas omitted); F, tarsus II, lateral (medial setae and claw omitted). Scale=50 μm.

5, 4, 5, 4; leg III, 1, 2, 3, 3, 5, 4; leg IV, 1, 2, 3, 3, 4–5, 3. Tibiae I to III each with one bipectinate ventromedial seta and one slender ventral seta; tibia IV with two slender and smooth ventral setae; tibiae in general with three dorsal setae (in holotype and two paratypes one seta on tibia IV unilaterally absent). Tarsus I with three fossary setae equal in size, dorsolateral solenidion 10 μm long, small papilliform famulus, long ventral seta, and ventromedial setula (Fig. 3E). On tarsus II dorsomedial fossary seta more slender than dorsal and dorsolateral setae; dorsolateral solenidion slender, "hollow", 8 μm long (Fig. 3F). Tarsus III with four dorsal setae, two basal ones being separated by about height of segment; tarsus IV with three dorsal setae. On tarsi III and IV paired apical fossary setae shorter and more slender than dorsal fossary seta. Tarsi II to IV lacking ventral setae. Tarsi I and II each with pair of doubled pas; tarsi III and IV with pair of basally flattened, setiform pas.

Claws slender, with minute accessory tooth; claws of tarsus I shorter than those of following tarsi. Central sclerite with bidentate claw-like process.

*Female.* Idiosomal length 340 μm. Dorsal aspect similar to that of male, although PD slightly more slender; length of PD 175 μm, width 122 μm. Anterior margin of GA broadly arched. GO large, moved towards anterior margin of GA, with pair of internal genital acetabula (Fig. 2G). Genital sclerites with pair of subgenital setae. Ovipositor (at rest) not extending beyond GO. Genital spines of ovipositor long and spiniform. GA with three (unilaterally two) perigenital setae.

**Remarks.** Three *Acarothrix* species have been described previously, *A. palustris*, *A. longiunguis*, and *A. umgenica*. Both *A. longiunguis* and *A. umgenica* have very long and slender claws whereas those of *A. ampliata* and *A. palustris* are short; the claws of *A. ampliata* have an accessory tooth whereas the claws of the other species are smooth (Bartsch 1990, 1997; Proches 2002). Tibiae I and II each bear five setae in *A. ampliata*, but six in the other species. In contrast to *A. palustris*, *A. ampliata* has no prominent cerotegumental ornamentation. The integument between the plates in the new species is striated, and there are no turbercles with filaments like those of *A. longiunguis*. The ovipositor of *A. ampliata* is short, not extending beyond the GO, as it does in *A. palustris* and *A. longiunguis*, and the ocular plates are wide, far from being almost twice as long as wide as in *A. umgenica* (cf. Proches 2002, fig. 4A).

At low magnification *A. ampliata* resembles brackish-water *Copidognathus* species of muddy habitats. The genera are easily separated on the base of leg chaetotaxy. The setation formula of trochanters I to IV is 1, 1, 1, 1 in *Acarothrix* but 1, 1, 1, 0 in *Copidognathus*; that of the basifemora 2, 3, 2, 2 in *Acarothrix* but 2, 2, 2, 2 in almost all species of *Copidognathus*; tibiae I to IV bear 3–4/2, 3–4/2, 3/2, and 3/2 dorsal/ventral setae in *Acarothrix*, but 4/3, 4/3, 3/2, and 3/2 setae in the majority of *Copidognathus* species. *Werthella*, another copidognathine genus present in shallow-water areas, often has a similar flattened idiosoma covered more or less densely with filaments. The palps of *Werthella* species bear a single basal seta on P-4, in contrast to the three setae in *Acarothrix* and *Copidognathus*.

## Biogeographical and Ecological Remarks

The first record of *Acarothrix* was from Hong Kong, southern China, the second from Darwin, northern Australia, the third from Durban, southeastern Africa, and the present one from Florida, USA. All records are from the tropical zone and from muddy environments with fluctuating salinity.

The genus *Acarothrix* is expected to be circumtropical. The new record corroborates the hypothesis that halacarid mite genera are widespread and that endemisms, if present at all, are restricted to genera with very specialized life styles, e.g., living in a close symbiotic or parasitic association.

*Acarothrix* seems to be bound to tropical and warm-temperate waters. In the cold-temperate Rhode Island, USA, muddy tidal creeks and ditches with diluted brackish water were inhabited by the copidognathines *Copidognathus hylandi* Bartsch, 1979 and *C. poriferus* Bartsch, 1979, while the typical co-occurring brackish water fauna included *Almyracuma proximoculi* (Bartsch 1979, 1982), a cumacean present also in the Little Manatee River, Tampa Bay.

Most marine halacarid genera have three, rarely two, pairs of genital acetabula whereas copidognathines have a single pair, except perhaps *Phacacarus*. In the single described species of this genus (*P. flavellus* Bartsch, 1992) no genital acetabula were recognized (Bartsch 1992, 1994). The position of the acetabula, internal and concealed by the genital sclerites, or external, situated within or on the genital sclerites or the genital plate and opening externally, was used to distinguish between the marine Halacaridae and fresh-water Limnohalacaridae or Porohalacaridae (Viets 1927, 1933). Subsequently, however, the position of the acetabula in halacarid mites has been considered to be of no phylogenetic relevance (Bartsch 1989).

Copidognathines in general have a single pair of internal genital acetabula and the species living in fresh water often have enlarged epimeral pores in both females and males; an example is the above-mentioned *Copidognathus poriferus* from cold-temperate northeastern America (Bartsch 1979). In *Acarothrix*, females have internal genital acetabula, but males have externally opening acetabula. Such a sexual difference is not restricted to the copidognathine *Acarothrix* but is also known in a few species of the genera *Halacarellus* and *Thalassarachna* (Halacarinae) and *Isobactrus* (Rhombognathinae). Examples are the psammophilous littoral species *H. capuzinus* (Lohmann, 1893), *H. chersonesus* Bartsch, 1998, and *H. discretus* Bartsch, 1998 (Bartsch 1972, fig. 25L, 1998, figs 39, 48), the deep-sea species *T. alvina* (Bartsch, 1994) (Bartsch 1996, fig. 31), and the intertidal species *Isobactrus hutchinsoni* Newell, 1947 and *I. uniscutatus* (Viets, 1939) (Viets 1939, fig. 21; Newell 1947, fig. 76). In males of *Caspihalacarus hyrcanus* Viets, 1928 two of the three pairs of acetabula are enlarged and have moved to a position on the genital plate (Viets 1928, fig. 48). In the fresh-water genus *Porohalacarus*, the external acetabula in females are situated on the genital sclerites, and those in males on the genital plate posterior to the genital opening (Bartsch 1987, fig. 3).

Often the presence of external genital acetabula and enlarged epimeral pores seems to be correlated with a life in diluted brackish or fresh water, but their presence does not imply that populations of these species are bound to almost fresh water; they may thrive in 20–30‰ salinity as well. In contrast, not all species colonizing waters of less than 5‰ have enlarged acetabula or epimeral pores, as exemplified by *Copidognathus cooki* Bartsch, 2003, a species abundant in the upper Swan River, Perth, Western Australia, at about 2–6‰ (Bartsch 2003). Fine-structural analyses of external acetabula of water mites have revealed porose membranes and associated mitochondria, a situation typical in cells with transcellular transport in osmoregulatorily active areas (Alberti 1979; Alberti and Bader 1990). An external position is expected to be of competitive advantage in a life in diluted brackish or fresh water. But something else than merely osmoregulation must play a role, too, when males have external acetabula whereas females can do with internal ones, as in *Acarothrix*.

## Acknowledgement

Thanks are expressed to Stephen A. Grabe, Environmental Protection Commission of Hillsborough County, for providing the mites and collecting data.

## References

Alberti, G. 1979. Fine structure and probable function of genital papillae and Claparède organs of Actinotrichida. Pp. 501–507. *In*: Rodriguez, J. (Ed.) *Recent Advances in Acarology. II*. Academic Press, New York.

Alberti, G. and Bader, C. 1990. Fine structure of external 'genital' papillae in the freshwater mite *Hydrovolzia placophora* (Hydrovolziidae, Actinedida, Actinotrichida, Acari). Experimental & Applied Acarology 8: 115–124.

Bartsch, I. 1972. Ein Beitrag zur Systematik, Biologie und Ökologie der Halacariden (Acari) aus dem Litoral der Nord- und Ostsee. I. Systematik und Biologie. Abhandlungen und Verhandlungen des Naturwissenschaftlichen Vereins in Hamburg, (Neue Folge) 16: 155–230.

Bartsch, I. 1979. Halacaridae (Acari) von der Atlantikküste Nordamerikas. Beschreibung der Arten. Mikrofauna des Meeresbodens 79: 1–62.

Bartsch, I. 1982. Halacaridae (Acari) von der Atlantikküste des borealen Nordamerikas. Ökologische und tiergeographische Faunenanalyse. Helgoländer Meeresuntersuchungen 35: 13–46.

Bartsch, I. 1983. Vorschlag zur Neugliederung des Systems der Halacaridae (Acari). Zoologische Jahrbücher, Systematik, Ökologie und Geographie der Tiere 110: 179–200.

Bartsch, I. 1987. Zur Biologie, Ökologie und Verbreitung der süßwasserbewohnenden Halacaride *Porohalacarus alpinus* (Acari). Archiv für Hydrobiologie 111: 83–93.

Bartsch, I. 1989. Süsswasserbewohnende Halacariden und ihre Einordnung in das System der Halacaroidea (Acari). Acarologia 30: 217–239.

Bartsch, I. 1990. *Acarothrix palustris* gen. et. spec. nov. (Halacaroidea, Acari), ein Bewohner der Salzwiesen Südchinas. Zoologischer Anzeiger 224: 204–210.

Bartsch, I. 1992. *Phacacarus flavellus* gen. et spec. nov. (Copidognathinae, Halacaroidea, Acari), eine Meeresmilbe auf Kalkalgen. Zoologischer Anzeiger 228: 212–219.

Bartsch, I. 1994. Sexualdimorphismus bei Meeresmilben (Halacaridae, Acari). Übersicht und Beschreibung des Männchens von *Phacacarus flavellus*. Zoologischer Anzeiger 232: 61–74.

Bartsch, I. 1996. Halacarid mites (Acari) from the Mid-Atlantic Ridge. New records. Cahiers de Biologie Marine 37: 159–167.

Bartsch, I. 1997. Copidognathinae (Halacaridae, Acari) from northern Australia; description of four new species. Pp. 23–243. *In*: Hanley, J. R., Caswell, G., Megirian, D. and Larson, H. K. (Eds) *Proceedings of the Sixth International Biological Workshop. The Marine Flora and Fauna of Darwin Harbour, Northern Territory, Australia*. Western Australian Museum, Perth.

Bartsch, I. 1998. Halacarinae (Acari: Halacaroidea) from the northwestern Black Sea: A review. Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut 95: 143–178.

Bartsch, I. 2003. A new species of *Copidognathus* (Acari: Halacaridae: Copidognathinae) from Western Australia, with notes on Halacaridae in fresh and brackish water. Pp. 11–19. *In*: Smith, I. (Ed.) *An Acarological Tribute to David R. Cook—From Yankee Springs to Wheeny Creek*. Indira Publishing House, West Bloomfield, Michigan.

Newell, I. M. 1947. A systematic and ecological study of the Halacaridae of eastern North America. Bulletin of the Bingham Oceanographic Collection 10: 1–232.

Proches, S. 2002. New species of Copidognathinae (Acari: Halacaridae) from southern Africa. Journal of Natural History 36: 999–1007.

Viets, K. 1927. Die Halacaridae der Nordsee. Zeitschrift für Wissenschaftliche Zoologie 130: 83–173.

Viets, K. 1928. Wassermilben aus dem Schwarzen Meer, dem Kaspischen Meer und dem Aral-See. Abhandlungen. Naturwissenschaftlicher Verein zu Bremen 27: 47–80.

Viets, K. 1933. Vierte Mitteilung aus unterirdischen Gewässern (Hydrachnellae und Halacaridae, Acari). Zoologischer Anzeiger 102: 277–288.

Viets, K. 1939. Meeresmilben aus der Adria (Halacaridae und Hydrachnellae, Acari). Archiv für Naturgeschichte (Neue Folge) 8: 518–550.